

# **Numerical Modeling of Eddy Current Nondestructive Evaluation of Ferromagnetic Tubes via an Integral Equation Approach**

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In this contribution a Volume Integral Equation (VIE) formulation for the modeling of eddy current Nondestructive Evaluation (NDE) of ferromagnetic tubes is proposed. VIE-based models for nonmagnetic tubes are well established and successfully applied in the industry; however, the formulation of the more general problem of the ferromagnetic ones has not been sufficiently studied yet. The presence of material defects in this case results in a local variation of the magnetic permeability in addition to the variation of the conductivity met in nonmagnetic materials. This in turn requires a system of two integral equations, one for the electric field and one for the magnetic, in order to obtain a well determined problem. This system involves the full family of the Green's dyads.

The integral equation approach has specific advantages for this kind of applications. More precisely, the VIE formulation allows us to restrict the discretization to the flaw region only. Furthermore, it is well suited for the simulation of the complete scan of the detection probes, since the displacement of the probe changes only the excitation vector whereas the matrix of the discretized system remains the same for each probe position.

The proposed formulation is described and validated with experimental data, obtained by means of a Remote Field Eddy Current (RFEC) technique.